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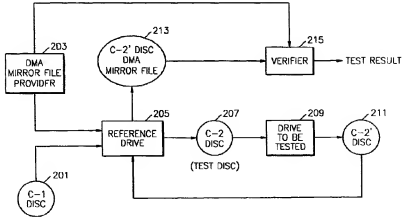
(54) Method of verifying defect management area information of disc and test apparatus for performing the same

(57) A method of verifying that defect management area (DMA) information is generated or updated normally when a disc recording and reproducing apparatus (209) performs reinitialization with secondary defect list (SDL) conversion without certification, and a test apparatus for performing the method. The method includes performing the reinitialization using a test disc (207) with test reference information and generating test information (213) from the defect management information which is generated after the reinitialization, and comparing reference information expected from the test reference information with the test information (213) and providing the result of verification of the test information. Accordingly, a user can test the DMA generation or updating function of a given disc recording and reproducing apparatus within a short period of time, and the cost for producing and providing the test disc can be saved.

FIG. 2



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Description

[0001] The present invention relates to an apparatus which can record information on and reproduce information from a recording and reproducing disc, and more particularly, to a method of verifying that a disc recording and reproducing apparatus normally generates or updates defect management area (DMA) information of a disc, and a test apparatus for performing the same.

[0002] A recording and reproducing disc is an optical disc, which information is recorded on and reproduced from using light such a laser beam, for example, a digital versatile disc random access memory (DVD-RAM). A DVD-RAM is a rewritable disc. According to "DVD Specifications for Rewritable Disc Part1 Physical Specifications Version 2.0," DVD-RAM includes four DMAs, i.e., DMA1, DMA2, DMA3 and DMA4, on each side thereof for managing the defects thereon.

[0003] As shown in Figure 1, DMA1 and DMA2 are located in a lead-in area near the inner diameter of a disc, and DMA3 and DMA4 are located in a lead-out area near the outer diameter of the disc. Each DMA is followed by a reserved sector.

[0004] A disc definition structure (DDS), a primary defect list (PDL) and a secondary defect list (SDL) are stored in the DMA. A DDS includes information on the format structure of a disc, for example, a disc certification flag, a DDS/PDL update counter and a start logical sector number of each zone. A PDL includes information on all defective sectors detected on the disc during initialization of the disc. An SDL includes information on the sector number of each first sector in defective blocks (error-correction code (ECC) blocks) occurring while the disc is in use, information on the sector number of each first sector in spare blocks used to replace defective blocks and information on a spare area.

[0005] Some information included in the DMA can be immediately read and used. On the other hand, the DMA includes information which varies with the positions and the number of defects on a disc. In addition, some information, for example, the position information of the start sector number of each zone or the position information of a logical sector number 0, can be obtained by performing an algorithm based on defect information registered in the DMA.

[0006] Four DMAs exist on each side of a disc to prevent erroneous defect management due to errors in the DMA information. Since such DMA information is closely related to a physical data sector, a recording medium such as a movable optical disc may not be compatible with two different disc recording and reproducing apparatuses when the DMA information is incorrectly written or read.

[0007] This is because, when the recording and reproducing architecture of a disc recording and reproducing apparatus (for example, a DVD-RAM recording and reproducing apparatus) is divided into a file system layer, a host interface layer for interfacing a host computer with the recording and reproducing apparatus, a physical disc recording and reproducing apparatus (or disc drive) layer for recording and reproducing physical signals, and a recording medium layer, writing and reading of DMA information is performed in the physical disc recording and reproducing apparatus layer and the layers therebelow. In an actual file system, user information to be recorded or reproduced is transmitted to a disc recording and reproducing apparatus based on only a logical sector number, and the disc recording and reproducing apparatus converts the logical sector number into a physical sector number to record or reproduce the user information. In this case, DMA information is used. Accordingly, when the DMA information has erroneously been read or written in a given disc recording and reproducing apparatus, data cannot be correctly read or written in another recording and reproducing apparatus.

[0008] Accordingly, a method of verifying that a disc recording and reproducing apparatus correctly reads DMA information recorded on a disc and correctly records DMA information on the disc for generation or update of DMA information is desired.

[0009] An aim of the present invention is to provide a method of verifying that defect management area (DMA) information is generated or updated normally when a disc recording and reproducing apparatus performs reinitialization with secondary defect list (SDL) conversion without certification.

[0010] A second aim of the present invention is to provide a method of verifying that the DMA information of a disc, which is generated using a blank disc and a test reference DMA mirror file configured such that every kind of defect information is included in a primary defect list, is generated or updated normally when a disc recording and reproducing apparatus performs reinitialization with SDL conversion without certification.

[0011] A third aim of the present invention is to provide a test apparatus for verifying that DMA information is generated or updated normally when a disc recording and reproducing apparatus performs reinitialization with SDL conversion without certification.

[0012] Additional aims and advantages of the invention will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the invention.

[0013] According to a first aspect of the invention there is provided a method of verifying the DMA information generation or updating function of a recording and reproducing apparatus, which records information on or reproduces information from a disc with DMA information. The method includes performing reinitialization without certification in the recording and reproducing apparatus using a test disc with test reference information and generating test information from the defect management information which is generated after the reinitialization, and comparing reference information expected from the test reference information with the test information and providing the result of verification of the

test information.

[0014] Also according to the present invention there is provided an apparatus for testing the DMA information generation or updating function of a recording and reproducing apparatus which records information on or reproduces information from a disc with DMA information. The apparatus includes a test disc with test reference information; a reference drive generating test information from DMA of the test disc after the recording and reproducing apparatus performs reinitialization without certification using the test disc; and a verifier comparing reference information, which is expected from the test reference information, with the test information and providing the result of verifying the test information.

[0015] Further according to the present invention there is provided a method of verifying whether defect management area (DMA) information is properly generated or updated in a recording and reproducing apparatus which records or reproduces information on or from an optical disc with the DMA information, the method comprising: setting a test reference according to a reinitialization with SDL conversion without certification test mode; generating test information from the DMA information, which is generated or updated by the recording and reproducing apparatus, according to the reinitialization with SDL conversion without certification test mode; and executing a test for verifying the test information using the test reference in the reinitialization with SDL conversion without certification test mode.

[0016] Also according to the present invention there is provided a method of verifying whether defect management area (DMA) information is properly generated or updated in a recording and reproducing apparatus which records or reproduces information on or from an optical disc with the DMA information, the method comprising: generating test information from the DMA information, which is generated or updated by the recording and reproducing apparatus, according to a reinitialization with SDL conversion without certification test mode; and verifying the test information using a test reference for verifying the DMA information.

[0017] Further according to the present invention there is provided an apparatus for testing a recording and reproducing apparatus which records or reproduces information on or from a recordable and reproducible optical disc with defect management area (DMA) information to check whether the DMA information is properly generated or updated, the apparatus comprising: a modified drive unit generating test information from the generated or updated DMA information of a test disc , which is obtained after the recording and reproducing apparatus performs reinitialization with SDL conversion without certification on the test disc with a DMA mirror file corresponding to the reinitialization with SDL conversion without certification; and a verifier comparing the test information with predetermined test information corresponding to the reinitialization with SDL conversion without certification to verify a test result. Further according to the present invention there is provided a method of verifying whether a recording and reproducing apparatus reads and processes defect management area (DMA) information properly, comprising: performing reinitialization with SDL conversion without certification on a test disc containing predetermined defect information using the reproducing and recording apparatus to generate test information; and comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus.

[0018] Also according to the present invention there is provided a method of verifying whether a recording and reproducing apparatus properly translates and processes defect information. the method comprising: preparing a test disc having known physical defects and a test reference DMA mirror file; generating test information based on having the recording and reproducing apparatus perform reinitialization with SDL conversion without certification on the test disc; and conducting a verification test on the test information. Further according to the present invention there is provided a method of verifying whether a recording and reproducing apparatus reads and processes defect management area (DMA) information properly, comprising: performing reinitialization with SDL conversion without certification on a test disc known physical defects and a test reference DMA mirror file using the reproducing and recording apparatus to generate the DMA information; generating test information from the generated DMA information; and comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus.

[0019] Further according to the present invention there is provided DMA information which is properly generated by a recording and reproducing apparatus using the process of: performing reinitialization with SDL conversion without certification on a test disc containing known physical defects and a test reference DMA mirror file using the reproducing and recording apparatus to generate the DMA information; generating test information from the generated DMA information; and comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus.

[0020] Also according to the present invention there is provided a recording and reproducing apparatus verified according to the process of: performing reinitialization with SDL conversion without certification on a test disc containing known physical defects and a test reference DMA mirror file using the reproducing and recording apparatus to generate the DMA information; generating test information from the generated DMA information; and comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus.

[0021] Further according to the present invention there is provided an apparatus for testing a recording

and reproducing apparatus which records or reproduces information on or form a recordable and reproducible optical disc with defect management area information to check whether DMA information is properly generated, the apparatus comprising: a modified driver generating test information based on the DMA information of a test disc generated by a reproducing device performing reinitialization with SDL conversion without certification on the test disc containing known physical defects and a test reference DMA mirror file using the reproducing and recording apparatus to generate the DMA information; and a verifier comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus.

[0022] Also according to the present invention there is provided a method of manufacturing a compliant recording and reproducing apparatus, comprising: manufacturing an uncertified recording and reproducing apparatus that updates and generates defect management area (DMA) information; and verifying whether the uncertified recording and reproducing apparatus is compliant with a standard, said verifying comprising: performing reinitialization with SDL conversion without certification on a test disc containing predetermined defect information and test reference DMA information using the recording and reproducing apparatus to generate test information, and comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus, the verification indicating that the uncertified recording and reproducing apparatus is compliant with the standard.

[0023] Further according to the present invention there is provided a disc recording and reproducing apparatus for recording and reproducing information on an optical disc, comprising: a light source to emit a light; a focusing element to focus the light onto the optical disc to record and reproduce the information; and a controller to control said light source, said controller being verified to update and generate defect management area (DMA) information by performing reinitialization with SDL conversion without certification on a test disc containing predetermined defect information and test reference DMA information using the recording and reproducing apparatus to generate test information, and comparing the test information with reference test information to determine the verification of the recording and reproducing apparatus.

[0024] These and other aspects of the invention are defined in the appended claims.

[0025] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

Figure 1 shows the schematic configuration of a rewritable disc;

Figure 2 is a block diagram showing the functioning of a test apparatus according to the present invention;

Figure 3 shows an example of the defect structure of a C-2 disc;

Figures 4A through 4D are examples of detailed check lists for verification performed by the verifier of Figure 2;

Figure 5 is a block diagram showing the relation between a primary defect list (PDL) and a secondary defect list (SDL) in the defect management area (DMA) of a C-2 disc before reinitialization and the PDL and the SDL in the DMA of the C-2 disc after the reinitialization, respectively;

Figure 6 is a flowchart of a verification method according to the present invention; and

Figure 7 is a block diagram of the drive to be tested shown in Figure 2.

[0026] Reference will now made in detail to the present preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

[0027] Referring to Figure 2, a test apparatus includes a C-1 disc 201, a defect management area (DMA) mirror file provider 203, a reference drive 205, a C-2 disc 207, a drive to be tested 209, a C-2 disc 211, a C-2 disc DMA mirror file 213 and a verifier 215.

[0028] The C-1 disc 201 is a test disc which is made to have intentional physical defects for the purpose of testing a disc drive which can record information on or reproduce information from a rewritable disc such as a digital versatile disc random access memory (DVD-RAM), and is substantially a blank disc on which no information is recorded. As long as no "information" is recorded and only intentional "defects" are present on the C-1 disc 201, the C-1 disc 201 may be regarded as blank. Accordingly, the physical defects on the C-1 disc 201 are used as known information when the disc drive is tested. In addition, the C-1 disc 201 is designed to satisfy conditions of a phase change recording DVD-RAM which has a capacity of 4.7 gigabytes (GB) prescribed in the "DVD Specifications for Rewritable Disc Version 2.0."

[0029] The DMA mirror file provider 203 provides a DMA mirror file which is test reference information including disc definition structure (DDS) information, primary defect list (PDL) information and secondary defect list (SDL) information, as shown in Figure 1, and satisfying a condition that a supplementary spare area (SSA)

is not full.

[0030] Particularly, the DMA mirror file provider 203 provides a test reference DMA mirror file which is configured such that all kinds of defects are included in the PDL. In other words, the test reference DMA mirror file has the PDL, which includes a P-list with information on defective sectors defined by a disc manufacturer, a G1-list with information on defective sectors detected during certification of a disc, and a G2-list with information on defective sectors which are shifted to the SDL without certification.

[0031] To increase the effect of a test, a test reference DMA mirror file, which includes information on defects located in particular positions which have the highest possibility of occurrence of errors, is provided when the drive to be tested 209 performs reinitialization. In other words, to satisfy all cases of an algorithm which are proposed by "DVD Specifications for Rewritable Disc Part1 Physical Specifications Version 2.0," the test reference DMA mirror file is configured to include information on defects concentrated around a physical sector located where a first logical sector is supposed to be located, as shown in Figure 3.

[0032] Also, the test reference DMA mirror file is characterized by that the first and last sectors of each zone are treated as erroneous ones and that defective sectors are set such that a total of available sectors in each zone is not a multiple of 16. A mirror file has the same content as an actual file, but is located at a position different from the physical position of the actual file.

[0033] The DMA mirror file provider 203 also provides the test reference DMA mirror file, in which the number of entries in the SDL exceeds the total number of available entries in the PDL, to consider an overflow state when the disc to be tested 209 performs reinitialization with SDL conversion without certification on a disc.

[0034] The reference drive 205 is a modified test drive for testing an apparatus capable of recording information on and reproducing information from a disc. When the C-1 disc 201 is loaded into the reference drive 205 and the test reference DMA mirror file is provided from the DMA mirror file provider 203, the reference drive 205 records the test reference DMA mirror file on the C-1 disc 201 to generate the C-2 disc 207. The test reference DMA mirror file is recorded onto the C-1 disc 201 regardless of physical defects on the C-1 disc 201. Accordingly, the C-2 disc 207 includes the physical defects of the C-1 disc 201 and test reference DMA mirror file information in which all kinds of defect information are included in the PDL regardless of the physical defects. Like the C-1 disc 201, the C-2 disc 207 satisfies the conditions of a phase change recording DVD-RAM which has a capacity of 4.7 GB. The DMA information recorded on the C-2 disc 207 is what is known to the user.

[0035] When the C-2 disc 211, which is reinitialized with SDL conversion without certification, is loaded into the reference drive 205, the reference drive 205 immediately reads DMA information recorded on the C-2 disc 211 and outputs a read C-2 disc DMA mirror file 213 based on the DMA information, as test information. The test information may be part of the C-2 disc DMA mirror file 213. For example, the part may be the information corresponding to that shown in Figure 4A.

[0036] The drive to be tested 209 is a disc recording and reproducing apparatus which can record information on and reproduce information from a rewritable disc. When the C-2 disc 207 is loaded into the drive to be tested 209, the drive to be tested 209 performs reinitialization with SDL conversion without certification, thereby generating or updating the test reference DMA information contained in the C-2 disc 207.

[0037] In other words, when the drive to be tested 209 reinitializes the C-2 disc 207 with registering SDL entries in the G2-list of PDL without certification, the entries in the SDL of the C-2 disc 207 are registered in the PDL in the form of a G2 entry type. Consequently, the PDL of the DMA on the C-2 disc 211 which is generated by the drive to be tested 209 includes the entries in the SDL of the C-2 disc 207. The C-2 disc 211 including the generated or updated DMA information is loaded into the reference drive 205, and thus test information is output as described above.

[0038] The test information from the reference drive 205 is provided to the verifier 215. In providing the test information, the reference drive 205 may immediately provide the test information to the verifier 215.

[0039] The verifier 215 verifies the C-2 disc DMA mirror file 213 using expected reference information (expected values) on DMA which is obtained when the drive to be tested 209 performs normally the reinitialization with SDL conversion without certification on the C-2 disc 207. The expected reference information may be set by the verifier 215 based on the test reference DMA mirror file provided from the DMA mirror file provider 203 and the physical defect information contained in the previously provided C-1 disc 201. Alternatively, as shown in Figures 4A through 4D, DMA information tables may be previously prepared and used.

[0040] Figure 4A shows a check list which the verifier 215 can include for DMA verification. The check items of the list include an error condition of DMA1 through DMA4, DDS/PDL update counters in DDS1 through DDS4 and in SDL1 through SDL4, SDL update counters in SDL1 through SDL4, and contents of DMA1 through DMA4.

[0041] The error condition of a DMA item is for checking whether errors exist in DMAs, two of which are located in a lead-in area and two of which are located in a lead-out area. Uncorrectable errors must not exist in any of the four DMAs, DMA1, DMA2, DMA3 and DMA4. If any uncorrectable error is detected in any one of the DMAs, the test result is output to inform the user that the drive to be tested 209 failed in generating or updating the DMA of the C-2 disc 207. When the generation or updating of the DMA ends in failure, the user needs to retry the test from the beginning using another test

disc. To verify the DDS/PDL and SDL update counter item upon reinitialization, the values "M+k," which indicate the values of DDS/PDL update counters in four DDSs, i.e., DDS1, DDS2, DDS3 and DDS4, and in four SDLs, i.e., SDL1, SDL2, SDL3 and SDL4, are checked to find whether the value "M" is a previous value and whether the value "k" is "1," because each DDS/PDL update counter value is increased by one when the DDS/PDL is updated or rewritten. The "previous value" means the value of "M" before the drive to be tested 209 performs the reinitialization with SDL conversion without certification. It is also checked whether the values of the eight DDS/PDL update counters in the four DMAs, i.e., DMA1, DMA2, DMA3 and DMA4, are the same.

[0042] The values "N+k," which indicate the values of SDL update counters in four SDLs, i.e., SDL1, SDL2, SDL3 and SDL4, are checked to find whether the value "N" is a previous value and whether the value "k" is "1," because each SDL update counter value is increased by one when the SDL is updated or rewritten. The "previous value of "N" before the drive to be tested 209 performs the reinitialization with SDL conversion without certification. It is also checked whether the values of the four SDL update counters are the same.

[0043] In addition, it is checked whether the contents of the four DMAs, i.e., DMA1, DMA2, DMA3 and DMA4, are the same. Figure 4B shows a check list which the verifier 215 can include for verification of the DDS. The check items of the list include a DDS identifier, a disc certification flag, a DDS/PDL update counter, a number of groups, a number of zones, a location of a primary spare area, a location of a first logical sector number (LSN0), a start LSN for each zone, etc.

[0044] It is verified that the DDS identifier is "0A0Ah. " It is checked whether the value of the bit position b7, which indicates in-progress/not in-progress, in the one byte of the disc certification flag, is "0b." If the value of the bit position b7 is "0b," this indicates that formatting is completed. If the value of the bit position b7 is "1b," this indicates that formatting is in progress. Accordingly, when the value of the bit position b7 is "1b," the verifier 215 determines that formatting has failed. In addition, it is checked whether reserved bit positions b6 through b2 in the disc certification flag are all "0b," and it is checked whether the value of a bit position b1 indicating a user certification flag is "1b." It is also checked whether the value of a bit position b0 indicating a disc manufacturer certification flag is "1b." To verify the corresponding DDS/PDL update counter, it is checked whether a value M indicating the DDS/PDL update counter value is a previous value, and whether a value **k** indicating the increment of the DDS/PDL update counter representing a difference in the DDS/PDL update counter "M" before and after a test is "1." It is also checked whether the value of the number of groups is "0001h" indicating that the number of groups is 1, and whether the value of the number of zones is "0023h," indicating that the number of zones is 35.

[0045] Moreover, it is checked whether the first sector number of a primary spare area is "031000h," and whether the last sector number of the primary spare area is "0341FFh." It is checked whether the location of LSN0 and the start LSN for every zone, that is, the start LSNs of the second zone, Zone1, through the 35th, zone Zone34, are determined based on the number of defects registered in the PDL. The defects registered in the PDL cover the physical defects on the C-1 disc 201 and defects registered in the PDL of the test reference DMA mirror file provided from the DMA mirror file provider 203.

[0046] It is checked whether the remaining reserved areas (byte positions 396 to 2047) in the DDS structure are all "00h."

[0047] As shown in Figure 4C, check items for verifying the PDL structure include a PDL identifier, a number of entries in the PDL, an integrity of PDL entries and an un-used area.

[0048] It is checked whether the PDL identifier is "0001h." The number of entries in the PDL is the sum of the number of physical defects on the C-1 disc 201 and the number of defects registered in the PDL of the test reference DMA mirror file provided from the DMA mirror file provider 203. For verification of the integrity of each PDL entry, a type of entry and a defective sector number are checked. It is checked whether the PDL entry type has "00b" indicating a known P-list existing on the C-2 disc 207, "10b" indicating a G1-list of defective sectors detected during user certification, and "11b" indicating the G2-list generated due to the SDL conversion. Also, it is checked whether the defective sector numbers in the PDL are written in ascending order.

[0049] When the type of entry in the PDL is checked, it is checked whether all entry types of the P-list, G1-list and G2-list exist because, as shown in Figure 5, a P_list 511 and a G1_list 513 in an old PDL 510 in the DMA of the C-2 disc 207 are maintained in a P_list 531 and a G1_list 533 in a new PDL 530 in the DMA of the C-2 disc 211, respectively, and a G2_list 515 in the old PDL 510 and the defect information in an old SDL 520 are registered in a G2_list 535 in the new PDL 530. In addition, it is checked whether the un-used area is set to "FFh."

[0050] As shown in Figure 4D, check items for verifying the SDL structure include an SDL identifier, an SDL update counter, a start sector number of a secondary spare area (SSA), a total number of logical sectors, a DDS/PDL update counter, a spare area full flag, a number of entries in SDL, an integrity of SDL entries, an un-used area, reserved areas, etc.

[0051] It is checked whether the SDL identifier is "0002h." To verify the item of the corresponding SDL update counter, it is checked whether a value N indicating the SDL update counter value is a previous value, and whether a value **k** indicating an increment of the SDL update counter representing a difference in the SDL update counter "N" before and after a test is "1." To verify

the item of the corresponding DDS/PDL update counter, it is checked whether a value M indicating the DDS/PDL update counter value is a previous value, and whether a value k indicating the increment of the DDS/PDL update counter is "1."

[0052] It is checked whether the spare area full flag indicates that the secondary spare area is not full, and whether the number of entries in SDL is set to "00h," which is a value usually indicating there is none. Moreover, because the total used area of the SDL is known, if the number of entries in the SDL is checked, the size of the un-used area of the SDL can be determined. Accordingly, it is checked whether the size of the un-used area of the C-2 disc DMA mirror file 213 is equal to the size of the un-used area of the SDL, which is known based on the number of entries in the SDL and it is also checked whether the un-used area is set to "Ffh." Also, it is checked whether values of all reserved areas are "00h." This is because the defect information registered in the old SDL 520 on the C-2 disc 207 is all registered in the G2_list 535 in the new PDL 530, as shown in Figure 5, when the drive to be tested 209 performs normally the reinitialization with converting SDL into a G2-list without certification. In this case, the number of defects in the old SDL 520 is set not to exceed the total number of defects which can be registered in the old PDL 510. The total number of defects which can be registered in the old PDL 510 is the total number of defects which can newly be registered in the G2_list 515 in the old PDL 510. The total number of defects is used for considering defect information which is previously registered in the G2_list 515 in the old PDL 510.

[0053] When defects registered in the G2_list 515 in the old PDL 510 and defects registered in the old SDL 520 on the C-2 disc 207 overflow an area assigned to the G2_list 535 in the new PDL 530, defects remaining after the registration in the G2_list 535 are registered in a new SDL 540. Accordingly, when the defects overflow the G2_list 535, it needs to be checked whether the integrity of the SDL entries includes the defect information which is registered in the old SDL 520 but is not registered in the G2-list 535, after conversion to the G2-list. To make the overflow state occur, the number of defects registered in the old SDL 520 should be set to exceed the total number of defects which can be registered in the old PDL 510.

[0054] The verifier 215 verifies whether the drive to be tested 209 normally generates or updates DMA of the C-2 disc 207 during the reinitialization with SDL conversion without certification by comparing the reference information, which is set as shown in Figures 4A through 4D, with information contained in the C-2 disc DMA mirror file 213. The verified result is output as the result of testing the drive to be tested 209 in the mode of reinitialization with SDL conversion without certification. The verified result may be displayed for viewing by the user. For this, the present invention may include a display unit. Therefore, the user can be informed whether the drive to be tested 209 normally reads the DMA information from a disc and generates or updates the DMA in the mode of reinitialization with SDL conversion and without certification.

[0055] In addition, the verifier 215 considers that the above reinitialization mode is erroneous and outputs a corresponding result when it is determined that the drive to be tested 209 does not use spare blocks (ECC blocks) on the C-2 disc 207 during the SDL conversion.

[0056] Figure 6 is a flowchart of a verification method according to the present invention. The C-2 disc 207 is generated by recording the test reference DMA mirror file, which has conditions described in Figure 2, on the blank C-1 disc 201, which has conditions described in Figure 2, in operation 601. Next, in operation 602, the C-2 disc 207 is loaded into the drive to be tested 209, and the reinitialization is performed on the C-2 disc 207. During the reinitialization, SDL entries are converted into PDL entries, and the C-2 disc 207 is not certified. Accordingly, the defect information in the SDL is registered as the G2-list defect information in the PDL as described with reference to Figures 4A through 4D and Figure 5.

[0057] In operation 603, DMA information is read from the C-2 disc 211, and a C-2 disc DMA mirror file 213 is generated based on the DMA information. The C-2 disc DMA mirror file is used as test information. In the operation 603, part of the DMA mirror file can be extracted as test information, as described in Figure 2. The C-2 disc DMA mirror file 213 is verified in operation 604. The verification is performed using expected reference information (or expected values) as shown in Figures 4A through 4D in the same manner as performed by the verifier 215 described in Figure 2. After completing the verification, the result of the verification is output in operation 605 so that the user can estimate the DMA generation or updating function of the drive to be tested 209.

[0058] Figure 7 shows the drive to be tested 110 having a light source 22 to emit light, a focusing element 24 to focus the light from the light source on a disc D, and a controller 26 which controls the light source 22. The verification process described above seeks to verify the proper operation of the controller 26.

[0059] As described above, the present invention performs reinitialization with SDL conversion without certification on a C-2 disc, which is generated using a blank disc (a C-1 disc) on which no information is recorded, and a test reference DMA mirror file, which is proper for a test environment including all kinds of defect information, in a disc drive (a disc recording and reproducing apparatus). A DMA mirror file, which is obtained after the reinitialization with SDL conversion without certification, is verified to test the disc drive for a DMA generation or updating function, thereby allowing the user to verify the DMA generation or updating function of a given disc drive within a short period of time. In addition, according to the present invention, the user may personally produce the test disc (the C-2 disc), which satisfies conditions for converting SDL entries into PDL entries, using

the test reference DMA mirror file and the blank disc, thereby reducing the cost by not requiring a manufacturer to produce and provide the test disc described above. The user can produce the C-2 disc using the reference drive, the DMA mirror file provider, and the C-1 disc.

[0060] Although preferred embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles of the invention, the scope of which is defined in the claims and their equivalents.

[0061] The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0062] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0063] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0064] The invention is not restricted to the details of the foregoing embodiment(s). The invention extend to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A method of verifying a defect management area (DMA) information generation or updating function of a recording and reproducing apparatus which records information on or reproduces information from a disc with DMA information, the method comprising:

   performing reinitialization without certification in the recording and reproducing apparatus (209) using a test disc (207) with test reference information and generating test information (213) from the defect management information which is generated after the reinitialization; and

   comparing reference information expected from the test reference information with the test information and providing the result of verification of the test information.

2. The method of claim 1, wherein the test reference information is a mirror file.

3. The method of claim 1, wherein the test reference information is a DMA mirror file configured such that a plurality of kinds of defects are included in a primary defect list (PDL).

4. The method of claim 3, wherein the performing step comprises converting a secondary defect list (SDL) recorded on the test disc (207) into the PDL included in the test information.

5. The method of claim 4, wherein the test information is a mirror file.

6. The method of claim 5, wherein the comparing comprises checking whether all entries of the SDL are registered in a G2-list of the PDL, in a case where a number of defects registered in the SDL does not exceed a total number of entries which can be newly registered in the PDL when defect information registered in the SDL included in the test reference information is converted into defect information registered in the PDL.

7. The method of claim 5, wherein the comparing step comprises checking whether the SDL included in the test information is null.

8. The method of claim 5, wherein the comparing step comprises checking whether defect information registered in the SDL are registered in a G2-list of the PDL of the test information, and then checking whether defect information that is registered in the SDL but is not registered in the G2-list is registered in an SDL of the test information, in a case where a number of defects registered in the SDL exceeds a total number of entries which can be newly registered in the PDL when the defect information registered in the SDL included in the test reference information is converted into the defect information registered in the PDL.

9. The method of claim 5, wherein the comparing step comprises:

   verifying a structure of DMA of the test information;

   verifying a disc definition structure (DDS) of the test information;

   verifying a primary defect list (PDL) structure of the test information; and

verifying a secondary defect list (SDL) structure of the test information.

10. The method of claim 9, wherein the verifying of the DMA structure comprises checking a DMA error condition, DDS/PDL and SDL update counter and contents of DMA.

11. The method of claim 10, wherein:

the checking of the DMA error condition comprises checking whether errors exist in any one of four DMAs which is the DMA written in four positions on the test disc, two of which are located in a lead-in area and two of which are located in a lead-out area on the test disc;

the checking of the DDS/PDL update counters comprises checking whether the values of the DDS/PDL update counters in four DDSs and in four SDLs are "previous values," whether increments of the DDS/PDL update counters representing a difference in the DDS/PDL update counters before and after the performing of the reinitialization without certification are "1," and whether the values of the DDS/PDL update counters are the same;

the checking of the SDL update counters comprises checking whether values of the SDL update counters in the four SDLs are "previous values," whether increments of the SDL update counters representing a difference in the SDL update counters before and after the performing of the reinitialization without certification are "1," and whether the values of the SDL update counters are the same; and

the checking of the contents of the DMA comprises checking whether the contents of the four DMAs are the same.

12. The method of claim 9, wherein the verifying of the DDS comprises checking a DDS identifier, a disc certification flag, a DDS/PDL update counter, a number of groups, a number of zones, a location of a primary spare area, a location of a first logical sector number and a start logical sector number for each zone.

13. The method of claim 12, wherein:

the checking of the DDS identifier comprises checking whether the DDS identifier is a predetermined value;

the checking of the disc certification flag comprises checking whether a value of a bit indicating in-progress in the disc certification flag is "0b" and whether a value of a bit indicating disc manufacturer certification and a value of a bit indicating user certification are "1b";

the checking of the DDS/PDL update counter comprises checking whether the DDS/PDL update counter value is a "previous value" and whether an increment of the DDS/PDL update counter representing a difference in the DDS/PDL update counter before and after the performing of the reinitialization without certification is "1";

the checking of the number of groups comprises checking whether the number of groups is a predetermined number;

the checking of the number of zones comprises checking whether the number of zones is a predetermined number;

the checking of the location of the primary spare area comprises checking whether first and last sector numbers of the primary spare area are predetermined sector numbers, respectively;

the checking of the logical sector number comprises checking whether the location of the first logical sector number is determined based on a number of defects registered in the PDL; and

the checking of the start logical sector number comprises checking whether the start logical sector number for each zone is determined based on the number of defects registered in the PDL..

14. The method of claim 9, wherein the verifying of the PDL structure comprises checking a PDL identifier, a number of entries in the PDL and an integrity of the PDL entries.

15. The method of claim 14, wherein:

the checking of the PDL identifier comprises checking whether the PDL identifier is a predetermined value;

the checking of the number of entries comprises checking whether the number of entries in the PDL is the same as the number of defects registered in the PDL; and

the checking of the integrity of the PDS entries comprises checking whether the integrity of the PDL entries comprises all entries of a P-list, G1-list and a G2-list.

16. The method of claim 9, wherein the verifying of the SDL structure comprises checking an SDL identifier, an SDL update counter, a start sector number of a secondary spare area (SSA), a total number of logical sectors, a DDS/PDL update counter, a spare area full flag, a number of entries in the SDL, an integrity of the SDL entries, an un-used area, and reserved areas.

17. The method of claim 16, wherein:

the checking of the SDL identifier comprises checking whether the SDL identifier is a predetermined value;

the checking of the SDL update counter comprises checking whether the SDL update counter value is a "previous value" and whether an increment of the SDL update counter representing a difference in the SDL update counter before and after the performing of the reinitialization without certification is "1";

the checking of the DDS/PDL update counter comprises checking whether the DDS/PDL update counter value is a "previous value" and whether an increment of the DDS/PDL update counter representing a difference in the DDS/PDL update counter before and after the performing of the reinitialization without certification is "1";

the checking of the start sector number and the total number of logical sectors comprises checking whether the start sector number of the SSA and the total number of logical sectors are properly set according to a size of the SSA which is designated by a user;

the checking of the spare area full flag, the number of entries of the SDL and the integrity of the SDL entries comprises checking whether the spare area full flag indicates that the SSA is not full, whether the number of entries in the SDL is set to "00h" indicating that no entries exist, and whether no information on the SDL entries exists; and

the checking of the un-used area and the reserved areas comprises checking a size of the un-used area of the SDL and whether the un-used area is a predetermined value, and whether the reserved areas are predetermined values.

18. The method of claim 16, wherein:

the checking of the SDL identifier comprises checking whether the SDL identifier is a predetermined value;

the checking of the SDL update counter comprises checking whether the SDL update counter value is a "previous value" and whether an increment of the SDL update counter representing a difference in the SDL update counter before and after the performing of the reinitialization without certification is "1";

the checking of the DDS/PDL update counter comprises checking whether the DDS/PDL update counter value is a "previous value" and whether an increment of the DDS/PDL update counter representing a difference in the DDS/PDL update counter before and after the performing of the reinitialization without certification is "1";

the checking of the start sector number and the total number of logical sectors comprises checking whether the start sector number of the SSA and the total number of logical sectors are properly set according to a size of the SSA which is designated by a user;

the checking of the spare area full flag, the number of entries of the SDL and the integrity of the SDL entries comprises checking whether surplus defect information of the SDL is registered in an SDL of the test information in a case where a number of defects in the SDL overflows an area assigned to a G2-list of the PDL during the SDL conversion when the spare area full flag indicates that the SSA is not full; and

the checking of the un-used area and the reserved areas comprises checking a size of the un-used area of the SDL and whether the un-used area is a predetermined value, and whether the reserved areas are predetermined values.

19. The method of claim 4, wherein the comparing comprises outputting the verified result as the reinitialization mode being erroneous in response to determining that the recording and reproducing apparatus does not use spare blocks on the test disc (207) during the conversion of the SDL.

20. The method of claim 1, wherein the test disc (207) includes defect information on locations satisfying conditions in which an error readily occurs during the performing of the reinitialization without certification.

21. The method of claim 20, wherein the test disc com-

prises first and last sectors of each zone which are treated as erroneous ones, and a total number of available sectors in each zone is not a multiple of 16.

22. The method of claim 1, further comprising recording the test reference information on a blank disc (201) to generate the test disc (207).

23. The method of claim 22, wherein the recording of the test reference information comprises recording the test reference information on the blank disc regardless of a physical condition of the blank disc.

24. The method of claim 1, further comprising displaying the verified result as a result of testing the DMA generation or updating function of the recording and reproducing apparatus.

25. An apparatus for testing a defect management area (DMA) information generation or updating function of a recording and reproducing apparatus which records information on or reproduces information from a disc with DMA information, the apparatus comprising:

a reference drive (205) generating test information from a DMA of a test disc with test reference information and physical defects after the recording and reproducing apparatus (209) performs reinitialization without certification on the test disc (211); and

a verifier (215) comparing reference information, which is expected from the test reference information, with the test information (213) and providing a result of verifying the test information.

26. The apparatus of claim 25, wherein the test reference information is a mirror file.

27. The apparatus of claim 25, wherein the test reference information is a DMA mirror file comprising a plurality of kinds of defects included in a primary defect list (PDL).

28. The apparatus of claim 27, wherein the reference drive (205) directly reads the test information from the test disc which is reinitialized with conversion of a secondary defect list (SDL) into the PDL in the recording and reproducing apparatus.

29. The apparatus of claim 28, wherein the test information is a mirror file.

30. The apparatus of claim 29, wherein the verifier (215) checks whether all entries of the SDL are registered in a G2-list of the PDL, in a case where a number of defects registered in the SDL does not exceed a total number of entries which can be newly registered in the PDL when defect information registered in the SDL included in the test reference information is converted into defect information registered in the PDL.

31. The apparatus of claim 29, wherein the verifier (215) checks whether defect information registered in the SDL are registered in a G2-list of the PDL of the test information, and then checks whether the defect information that is registered in the SDL but is not registered in a G2-list is registered in an SDL of the test information, in a case where a number of defects registered in the SDL exceeds a total number of entries which can be newly registered in the PDL when defect information registered in the SDL included in the test reference information is converted into defect information registered in the PDL.

32. The apparatus of claim 29, wherein the verifier (215) checks whether the SDL included in the test information is null.

33. The apparatus of claim 29, wherein the verifier (215) outputs the verified result indicating the reinitialization to be erroneous in response to determining that the recording and reproducing apparatus does not use spare blocks on the test disc during the conversion.

34. The apparatus of claim 29, wherein the verifier (215) verifies a structure of a DMA, a disc definition structure (DDS), a primary defect list (PDL) structure and a secondary defect list (SDL) structure in the test information.

35. The apparatus of claim 34, wherein the verifier (215) verifies the DMA structure by checking an error condition of the DMA, DDS/PDL and SDL update counters and contents of the DMA.

36. The apparatus of claim 35, wherein to verify the DMA structure, the verifier (215) checks whether errors exist in any one of four DMAs, which is the DMA written in four positions on the test disc, two of which are located in a lead-in area and two of which are located in a lead-out area on the test disc, whether values of DDS/PDL update counters in four DDSs and in four SDLs are "previous values," whether increments of the DDS/PDL update counters representing a difference in the DDS/PDL update counters before and after the performing of the reinitialization without certification are "1," whether the values of the DDS/PDL update counters are the same, whether values of SDL update counters in

the four SDLs are "previous values," whether the increments of the SDL update counters representing a difference in the SDL update counters before and after the performing of the reinitialization without certification are "1," whether the values of the SDL update counters are the same, and whether contents of the four DMAs are the same.

37. The apparatus of claim 34, wherein the verifier (215) verifies the DDS by checking a DDS identifier, a disc certification flag, a DDS/PDL update counter, a number of groups, a number of zones, a location of a primary spare area, a location of a first logical sector number and a start logical sector number for each zone.

38. The apparatus of claim 37, wherein to verify the DDS, the verifier (215) checks the DDS identifier, checks whether a value of a bit indicating in-progress in the disc certification flag is "0b," whether a value of a bit indicating disc manufacturer certification and a value of a bit indicating user certification are "1b," whether the DDS/PDL update counter value is a "previous value" and whether an increment of the DDS/PDL update counter representing a difference in the DDS/PDL update counter before and after the performing of the reinitialization without certification is "1," checks the number of groups, the number of zones and first and last sector numbers of the primary spare area, and checks whether the location of the first logical sector number is determined based on a number of defects registered in the PDL and whether the start logical sector number for each zone is determined based on the number of defects registered in the PDL.

39. The apparatus of claim 34, wherein the verifier (215) verifies the PDL structure by checking a PDL identifier, a number of entries in the PDL and an integrity of PDL entries.

40. The apparatus of claim 39, wherein to verify the PDL structure, the verifier (215) checks whether the PDL identifier is a predetermined value and checks whether the number of entries in the PDL is the same as a number of defects registered in the PDL and whether the integrity of PDL entries comprises all entries of a P-list, G1-list and a G2-list.

41. The apparatus of claim 34, wherein the verifier (215) verifies the SDL structure by checking an SDL identifier, an SDL update counter, a start sector number of a secondary spare area (SSA), a total number of logical sectors, a DDS/PDL update counter, a spare area full flag, a number of entries in the SDL, an integrity of the SDL entries, an un-used area, and reserved areas.

42. The apparatus of claim 41, wherein to verify the SDL structure, the verifier (215) checks the SDL identifier and checks whether the SDL update counter value is a "previous value," whether an increment of the SDL update counter representing a difference in the SDL update counter before and after the performing of the reinitialization without certification is "1," whether the DDS/PDL update counter value is a "previous value," whether an increment of the DDS/PDL update counter representing a difference in the DDS/PDL update counter before and after the performing of the reinitialization without certification is "1," whether the start sector number of the SSA and the total number of logical sectors are properly set according to the size of a the SSA which is designated by a user, whether the spare area full flag indicates that the SSA is not full whether the number of entries in the SDL is set to "00h" indicating that no entries exist, whether no information on the SDL entries exists, a size of the un-used area of the SDL and whether the un-used area is a predetermined value, and whether the reserved areas are predetermined values.

43. The apparatus of claim 41, wherein the verifier (215) checks the SDL identifier and checks whether the SDL update counter value is a "previous value, " whether an increment of the SDL update counter is "1," whether the DDS/PDL update counter value is a "previous value," whether an increment of the DDS/PDL update counter is "1," whether the start sector number of the SSA and the total number of logical sectors are properly set according to the size of the SSA which is designated by a user, whether the spare area full flag indicates that the SSA is not full, whether surplus defect information of the SDL is registered in an SDL of the test information in a case where a number of defects in the SDL overflows an area assigned to a G2-list of the PDL during the SDL conversion, a size of the un-used area of the SDL and whether the un-used area is a predetermined value, and whether the reserved areas are predetermined values.

44. The apparatus of claim 25, wherein the reference drive (205) records the test reference information on a blank disc (201) to generate the test disc (207).

45. The apparatus of claim 44, wherein the reference drive (205) records the test reference information on the blank disc regardless of a physical condition of the blank disc.

46. The apparatus of claim 25, wherein the test disc (207) comprises defect information on locations satisfying conditions in which an error readily occurs, during the reinitialization.

47. The apparatus of claim 46, wherein the test disc (207) comprises first and last sectors of each zone which are treated as erroneous ones, and a total number of available sectors in each zone is not a multiple of 16.

48. The apparatus of claim 25, further comprising a display displaying the verified result as a result of testing the DMA generation or updating function of the recording and reproducing apparatus.

49. A method of verifying whether defect management area (DMA) information is properly generated or updated in a recording and reproducing apparatus which records or reproduces information on or from an optical disc with the DMA information, the method comprising:

setting a test reference according to a reinitialization with SDL conversion without certification test mode;

generating test information from the DMA information, which is generated or updated by the recording and reproducing apparatus (209), according to the reinitialization with SDL conversion without certification test mode; and

executing a test for verifying the test information (213) using the test reference in the reinitialization with SDL conversion without certification test mode.

50. The method of claim 49, wherein the test information is a DMA mirror file.

51. The method of claim 49, wherein the test information is directly read from a DMA area on a disc used for a test.

52. The method of claim 49, wherein the generating of the test information comprises recording pre-fixed contents of a DMA and selecting a DMA mirror file, in which the supplementary spare area is not full.

53. The method of claim 52, further comprising:

obtaining a first test disc (201) by forming known physical defects on a blank disc; and

obtaining a second test disc (207) by recording pre-fixed contents of a DMA in the first test disc, and recording a mirror file indicating that the supplementary spare area is not full in the first test disc, and using the second test disc (207) in generating the test information.

54. The method of claim 53, wherein the executing of the test comprises performing the reinitialization with SDL conversion without certification and with SDL list conversion, checking whether the DMA information of the second test disc complies with a predetermined DMA structure and whether a P-list and a G1-list are maintained, and checking a primary defect list (PDL) and a secondary defect list (SDL) for the SDL list conversion and a start logical sector number of each zone of the second test disc.

55. A method of verifying whether defect management area (DMA) information is properly generated or updated in a recording and reproducing apparatus which records or reproduces information on or from an optical disc with the DMA information, the method comprising:

generating test information from the DMA information, which is generated or updated by the recording and reproducing apparatus, according to a reinitialization with SDL conversion without certification test mode; and verifying the test information using a test reference for verifying the DMA information.

56. The method of claim 55, wherein the test information is a DMA mirror file.

57. An apparatus for testing a recording and reproducing apparatus which records or reproduces information on or from a recordable and reproducible optical disc with defect management area (DMA) information to check whether the DMA information is properly generated or updated, the apparatus comprising:

a modified drive unit (205) generating test information from the generated or updated DMA information of a test disc (207), which is obtained after the recording and reproducing apparatus (209) performs reinitialization with SDL conversion without certification on the test disc (207) with a DMA mirror file corresponding to the reinitialization with SDL conversion without certification; and

a verifier (215) comparing the test information with predetermined test information corresponding to the reinitialization with SDL conversion without certification to verify a test result.

58. The apparatus of claim 57, wherein the test information is a DMA mirror file.

59. The apparatus of claim 57, wherein the modified drive unit (205) reads the test information from a DMA area on the test disc and provides the test information to the verifier.

60. The apparatus of claim 59, wherein the test disc (207) is a second test disc on which pre-fixed contents of a DMA are recorded in a first test disc (201) on which known physical defects are formed on a blank disc, and on which a mirror file that the supplementary spare area is not full is recorded.

61. The apparatus of claim 60, wherein the verifier (215) checks whether the DMA information of the second test disc complies with a predetermined DMA structure and whether a P-list and a G1-list are maintained, and checks a primary defect list (PDL) and a secondary defect list (SDL) for SDL list conversion and a start logical sector number of each zone of the second test disc.

62. A method of verifying whether a recording and reproducing apparatus reads and processes defect management area (DMA) information properly, comprising:

performing reinitialization with SDL conversion without certification on a test disc (207) containing predetermined defect information using the reproducing and recording apparatus (209) to generate test information; and

comparing the test information (213) with reference test information to determine a verification of the recording and reproducing apparatus.

63. The method of claim 61, further comprising:

making known physical defects at predetermined positions in a blank disc, to produce a first test disc (201);

obtaining a second test disc (207) by recording pre-fixed contents of a DMA in the first test disc, and recording a mirror file indicating that a supplementary spare area is not full in the first test disc;

having the recording and reproducing apparatus (209) perform the reinitialization with SDL conversion without certification on the second test disc, to generate a second test disc with the DMA information; and

reading only the DMA information from the second test disc with the DMA information using a reference drive (205), to generate a test DMA mirror file as the test information;

wherein the reference test information is a reference DMA mirror file.

64. The method of claim 63, wherein the comparing comprises checking whether the DMA information of the second test disc complies with a predetermined DMA structure, checking whether the DMA information of the second test disc complies with a predetermined DMA structure and whether a P-list and a G1-list are maintained, and checking a primary defect list (PDL) and a secondary defect list (SDL) for SDL list conversion and a start logical sector number of each zone of the second test disc

65. A method of verifying whether a recording and reproducing apparatus properly translates and processes defect information, the method comprising:

preparing a test disc (207) having known physical defects and a test reference DMA mirror file;

generating test information (213) based on having the recording and reproducing apparatus perform reinitialization with SDL conversion without certification on the test disc; and

conducting a verification test on the test information.

66. The method of claim 65, wherein the test reference DMA mirror file comprises information on defects concentrated around a physical sector located where a first logical sector is supposed to be located.

67. The method of claim 66, wherein the test reference DMA mirror file comprises first and last sectors of each zone which are treated as erroneous ones, and defective sectors are set such that a total of available sectors in each zone is not a multiple of 16.

68. A method of verifying whether a recording and reproducing apparatus reads and processes defect management area (DMA) information properly, comprising:

performing reinitialization with SDL conversion without certification on a test disc (207) known physical defects and a test reference DMA mirror file using the reproducing and recording apparatus to generate the DMA information;

generating test information from the generated DMA information; and

comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus

69. The method of claim 68, wherein the test reference

DMA mirror file comprises information on defects concentrated around a physical sector located where a first logical sector is supposed to be located.

70. The method of claim 69, wherein the test reference DMA mirror file comprises first and last sectors of each zone which are treated as erroneous ones, and defective sectors are set such that a total of available sectors in each zone is not a multiple of 16.

71. The method of claim 68, wherein the comparing comprises checking a structure of a DMA, a disc definition structure (DDS) of the DMA, a primary defect list (PDL) structure and a secondary list (SDL) structure of the DMA, which form the test information.

72. DMA information which is properly generated by a recording and reproducing apparatus using the process of:

performing reinitialization with SDL conversion without certification on a test disc (207) containing known physical defects and a test reference DMA mirror file using the reproducing and recording apparatus to generate the DMA information;

generating test information from the generated DMA information; and

comparing the test information (213) with reference test information to determine a verification of the recording and reproducing apparatus.

73. The DMA information of claim 72, wherein the test reference DMA mirror file comprises information on defects concentrated around a physical sector located where a first logical sector is supposed to be located.

74. The DMA information of claim 73, wherein the test reference DMA mirror file comprises first and last sectors of each zone which are treated as erroneous ones, and defective sectors are set such that a total of available sectors in each zone is not a multiple of 16.

75. The DMA information of claim 72, wherein the comparing comprises checking a structure of a DMA, a disc definition structure (DDS) of the DMA, a primary defect list (PDL) structure and a secondary list (SDL) structure of the DMA, which form the test information.

76. A recording and reproducing apparatus verified according to the process of:

performing reinitialization with SDL conversion without certification on a test disc (207) containing known physical defects and a test reference DMA mirror file using the reproducing and recording apparatus to generate the DMA information;

generating test information (213) from the generated DMA information; and

comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus.

77. The recording and reproducing apparatus of claim 76, wherein the test reference DMA mirror file comprises information on defects concentrated around a physical sector located where a first logical sector is supposed to be located.

78. The recording and reproducing apparatus of claim 77, wherein the test reference DMA mirror file comprises first and last sectors of each zone which are treated as erroneous ones, and defective sectors are set such that a total of available sectors in each zone is not a multiple of 16.

79. The recording and reproducing apparatus of claim 76, wherein the comparing comprises checking a structure of a DMA, a disc definition structure (DDS) of the DMA, a primary defect list (PDL) structure and a secondary list (SDL) structure of the DMA, which form the test information.

80. A recording and reproducing apparatus verified according to the process of:

performing reinitialization with SDL conversion without certification on a test disc containing known physical defects and a test reference DMA mirror file using the reproducing and recording apparatus to generate the DMA information; and

comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus.

81. The recording and reproducing apparatus of claim 80, wherein the test reference DMA mirror file comprises information on defects concentrated around a physical sector located where a first logical sector is supposed to be located.

82. The recording and reproducing apparatus of claim 81, wherein the test reference DMA mirror file com-

prises first and last sectors of each zone which are treated as erroneous ones, and defective sectors are set such that a total of available sectors in each zone is not a multiple of 16.

83. The recording and reproducing apparatus of claim 80, wherein the comparing comprises checking a structure of a DMA, a disc definition structure (DDS) of the DMA, a primary defect list (PDL) structure and a secondary list (SDL) structure of the DMA, which form the test information.

84. An apparatus for testing a recording and reproducing apparatus which records or reproduces information on or form a recordable and reproducible optical disc with defect management area information to check whether DMA information is properly generated, the apparatus comprising:

a modified driver (205) generating test information based on the DMA information of a test disc generated by a reproducing device performing reinitialization with SDL conversion without certification on the test disc containing known physical defects and a test reference DMA mirror file using the reproducing and recording apparatus to generate the DMA information; and

a verifier (215) comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus.

85. The apparatus of claim 84, wherein the modified driver reads only the DMA information from the test disc with the DMA information, to generate a DMA mirror file as the test information;

wherein the reference test information is a reference DMA mirror file.

86. The apparatus of claim 84, wherein the modified driver generates a second test disc by recording pre-fixed contents of a DMA on a first test disc having known physical defects, and recording a test reference DMA mirror file indicating that the supplementary spare area is not full in the first test disc;

the recording and reproducing apparatus performs the reinitialization with SDL conversion without certification on the second test disc, to generate a second test disc with the DMA information; and

the modified driver reads only the DMA information from the second test disc with the DMA information, to generate a test DMA mirror file as the test information;

wherein the reference test information is a reference DMA mirror file.

87. The apparatus of claim 86, wherein the verifier checks whether the DMA information of the second test disc complies with a predetermined DMA structure, checks whether the DMA information of the second test disc complies with a predetermined DMA structure and whether a P-list and a G1-list are maintained, and checks a primary defect list (PDL) and a secondary defect list (SDL) for SDL list conversion and a start logical sector number of each zone of the second test disc.

88. The apparatus of claim 84, wherein the verifier compares the test information and the reference test information by checking a structure of a DMA, a disc definition structure (DDS) of the DMA, a primary defect list (PDL) structure and a secondary list (SDL) structure of the DMA, which form the test information.

89. The apparatus of claim 84, wherein the test reference DMA mirror file comprises information on defects concentrated around a physical sector located where a first logical sector is supposed to be located.

90. The apparatus of claim 89, wherein the test reference DMA mirror file comprises first and last sectors of each zone which are treated as erroneous ones, and defective sectors are set such that a total of available sectors in each zone is not a multiple of 16.

91. The apparatus of claim 57, further comprising a DMA mirror file provider which provides the reference test information to the verifier to make the comparison between the test information and the reference test information.

92. The apparatus of claim 75, further comprising a DMA mirror file provider which provides the reference test information to the verifier to make the comparison between the DMA mirror file and the reference DMA mirror file.

93. A method of manufacturing a compliant recording and reproducing apparatus, comprising:

manufacturing an uncertified recording and reproducing apparatus (209) that updates and generates defect management area (DMA) information; and

verifying whether the uncertified recording and reproducing apparatus is compliant with a standard, said verifying comprising:

performing reinitialization with SDL conversion without certification on a test disc (207) containing predetermined defect information and test reference DMA information using the recording and reproducing apparatus to generate test information (213), and comparing the test information with reference test information to determine a verification of the recording and reproducing apparatus, the verification indicating that the uncertified recording and reproducing apparatus is compliant with the standard.

94. The method of claim 93, wherein the comparing comprises checking a structure of a DMA, a disc definition structure (DDS) of the DMA, a primary defect list (PDL) structure and a secondary list (SDL) structure of the DMA, which form the test information.

95. A disc recording and reproducing apparatus for recording and reproducing information on an optical disc, comprising:

a light source (22) to emit a light;

a focusing element (24) to focus the light onto the optical disc to record and reproduce the information; and

a controller (26) to control said light source, said controller being verified to update and generate defect management area (DMA) information by performing reinitialization with SDL conversion without certification on a test disc containing predetermined defect information and test reference DMA information using the recording and reproducing apparatus to generate test information, and comparing the test information with reference test information to determine the verification of the recording and reproducing apparatus.

96. The disc recording and reproducing apparatus of claim 95, wherein the comparing comprises checking a structure of a DMA, a disc definition structure (DDS) of the DMA, a primary defect list (PDL) structure and a secondary list (SDL) structure of the DMA, which form the test information.

97. A disc recording and reproducing apparatus for recording and reproducing information on an optical disc:

a light source (22) to emit a light;

a focusing element (24) to focus the light onto the optical disc for recording and reproducing the information; and

a controller (26) to control said light source and to update and generate defect management area information after performing reinitialization with SDL conversion without certification on the optical disc so that the defect management information is compliant with a standard.

98. The disc recording and reproducing apparatus of claim 97, wherein the controller checks a structure of a DMA, a disc definition structure (DDS) of the DMA, a primary defect list (PDL) structure and a secondary list (SDL) structure of the DMA, which form the test information.

99. The method of claim 13, wherein the verifying of the DDS further comprises checking whether remaining reserved areas have a predetermined value.

100. The method of claim 15, wherein the verifying of the PDL structure comprises checking whether an unused area is a predetermined value.

101. The method of claim 53, wherein executing the test comprises verifying the test result to be a failure upon determining that the recording and reproducing apparatus does not use spare blocks on the second test disc during secondary list (SDL) conversion.

102. The apparatus of claim 60, wherein the verifier verifies the test result to be a failure upon determining that the recording and reproducing apparatus does not use spare blocks on the second test disc during secondary list (SDL) conversion.

103. The apparatus of claim 87, wherein the verifier verifies the test result to be a failure upon determining that the recording and reproducing apparatus does not use spare blocks on the second test disc during the secondary list (SDL) conversion.

FIG. 1

PRIOR ART

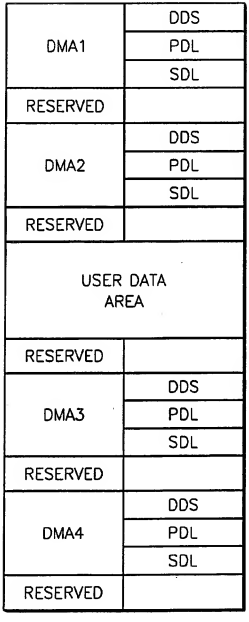


FIG. 2

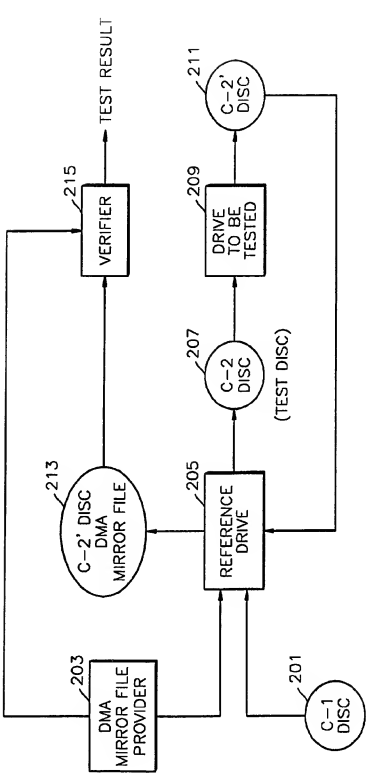

201
C-1 DISC
203
DMA MIRROR FILE PROVIDER
205
REFERENCE DRIVE
207
C-2 DISC
(TEST DISC)
209
DRIVE TO BE TESTED
211
C-2' DISC
213
C-2' DISC DMA MIRROR FILE
215
VERIFIER
TEST RESULT

FIG. 3

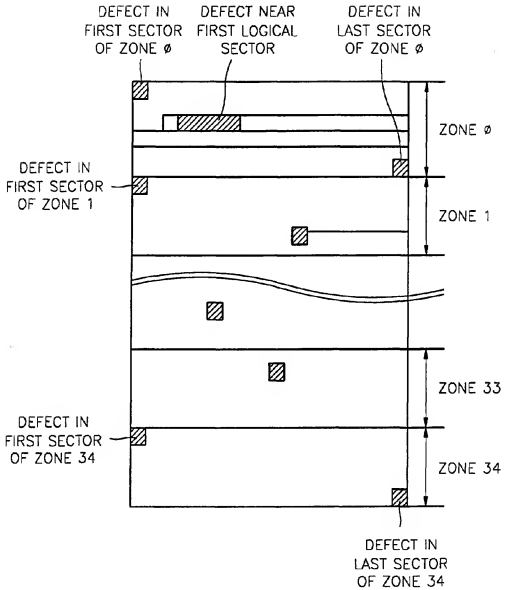

DEFECT IN FIRST SECTOR OF ZONE ø
DEFECT NEAR FIRST LOGICAL SECTOR
DEFECT IN LAST SECTOR OF ZONE ø
ZONE ø
DEFECT IN FIRST SECTOR OF ZONE 1
ZONE 1
ZONE 33
DEFECT IN FIRST SECTOR OF ZONE 34
ZONE 34
DEFECT IN LAST SECTOR OF ZONE 34

FIG. 4A

Class	Items		Byte Position	of bytes	Expected value
DMA	Error condition of DMA	DMA1	NA	NA	No uncorrectable error
		DMA2	NA	NA	No uncorrectable error
		DMA3	NA	NA	No uncorrectable error
		DMA4	NA	NA	No uncorrectable error
	DDS/PDL and SDL Update counters	DDS/PDL update counter in DDS1	4 to 7	4	M+k
		DDS/PDL update counter in SDL1	16 to 19	4	M+k
		DDS/PDL update counter in DDS2	4 to 7	4	M+k
		DDS/PDL update counter in SDL2	16 to 19	4	M+k
		DDS/PDL update counter in DDS3	4 to 7	4	M+k
		DDS/PDL update counter in SDL3	16 to 19	4	M+k
		DDS/PDL update counter in DDS4	4 to 7	4	M+k
		DDS/PDL update counter in SDL4	16 to 19	4	M+k
		SDL update counter in SDL1	4 to 7	4	N+k
		SDL update counter in SDL2	4 to 7	4	N+k
		SDL update counter in SDL3	4 to 7	4	N+k
		SDL update counter in SDL4	4 to 7	4	N+k
	Contents of DMA	DMA1	NA		Should be identical
		DMA2	NA		Should be identical
		DMA3	NA		Should be identical
		DMA4	NA		Should be identical

FIG. 4B

Class	Items		Byte Position	of bytes	Expected value	
DDS	DDS Identifier		0 to 1	2	0A0Ah	
	reserved		2	1	00h	
	Disc Certification flag		3	1	b7	0b
					b6-b2	All 0b
					b1	1b
					b0	X
	DDS/PDL update counter		4 to 7	4	M+k	
	Number of Groups		8 to 9	2	0001h	
	Number of zones		10 to 11	2	0023h	
	reserved		12 to 79	68	All 00h	
	Location of Primary spare area		80 to 87	8	b63-b56	00h
					b55-b32	031000h
					b31-b24	00h
					b23-b0	0341FFh
	Location of LSN0		88 to 91	4	b31-b24	00h
					b23-b0	-
	reserved		92 to 255	164	All 00h	
	Start LSN for each zone	Zone1	256 to 259	140	b31-b24	00h
					b23-b0	-
		Zone2	260 to 263		b31-b24	00h
					b23-b0	-
		...	...		...	...
		Zone34	392 to 395		b31-b24	00h
					b23-b0	-
	reserved		396 to 2047	1652	All 00h	

FIG. 4C

Class	Items		Byte Position	of bytes	Expected value	
PDL	PDL Identifier		0 to 1	2	0001h	
	Number of entries in PDL		2 to 3	2	E_{PDL}	
	Integrity of PDL entries	First PDL entry	4 to 7	4	b31-b30	
					b23-b0	
		Second PDL entry	8 to 11	4	b31-b30	
					b23-b0	
		. . .	. . .	. . .	. . .	. . .
		Last PDL entry	n to n+3	4	b31-b30	
					b23-b0	
		Size of PDL			$4xE_{PDL}+4$	
	Un-used area		n+4 to 30719		FFh	

FIG. 4D

Class	Items		Byte Position	of bytes	Expected value	
SDL	SDL identifier		0 to 1	2	0002h	
	reserved		2 to 3	2	00h	
	SDL Update counter		4 to 7	4	N+k	
	Start sector number of SSA		8 to 11	4	b31-b24	00h
					b23-b0	-
	Total number of logical sectors		12 to 15	4		
	DDS/PDL Update counter		16 to 19	4	M+k	
	Spare area full flag		20	1	b7-b2	All 0b
					b1	-
					b0	-
	reserved		21	1	00h	
	Number of entries in SDL		22 to 23	2	E_{SDL}	
	Integrity of SDL entries	First SDL entry	24 to 31	8	b63-b56	00h
					b55-b32	
					b23-b0	
		Second SDL entry	32 to 39	8	b62	
					b55-b32	
					b23-b0	
		. . .	. . .	. . .	. . .	. . .
		Last SDL entry	m to m+7	8	b62	
					b55-b32	
					b23-b0	
		Size of PDL			$8xE_{SDL}+24$	
	Un-used SDL area		m+8 to 32767		FFh	

FIG. 5

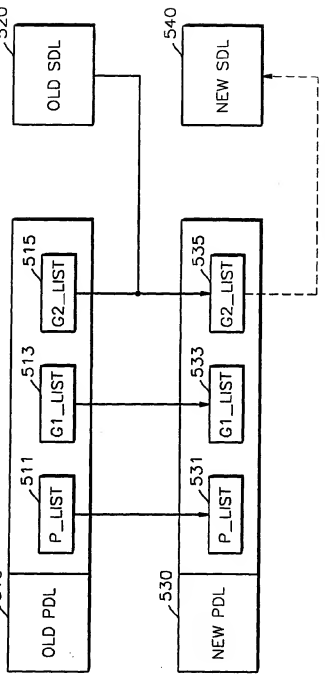
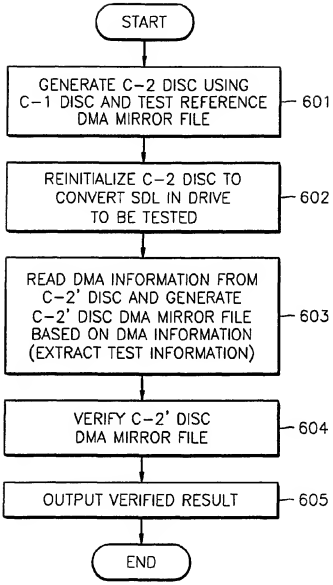

520
OLD SDL
540
NEW SDL
OVERFLOW
515
G2_LIST
513
G1_LIST
511
P_LIST
510
OLD PDL
535
G2_LIST
533
G1_LIST
531
P_LIST
530
NEW PDL

FIG. 6


START
GENERATE C-2 DISC USING C-1 DISC AND TEST REFERENCE DMA MIRROR FILE
601
REINITIALIZE C-2 DISC TO CONVERT SDL IN DRIVE TO BE TESTED
602
READ DMA INFORMATION FROM C-2' DISC AND GENERATE C-2' DISC DMA MIRROR FILE BASED ON DMA INFORMATION (EXTRACT TEST INFORMATION)
603
VERIFY C-2' DISC DMA MIRROR FILE
604
OUTPUT VERIFIED RESULT
605
END

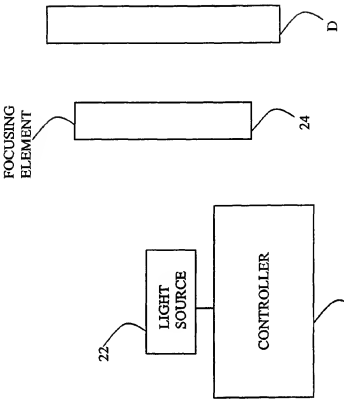



FIG. 7